MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2019/2020

DEM5038 – ENGINEERING MATHEMATICS 3

(Diploma in Electronic Engineering)

15 OCTOBER 2019
2.30 PM – 4.30 PM
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **2** pages excluding the cover page with **4** questions only.

2. Answer **ALL** questions. All necessary working steps must be shown.

3. Write all your answers in the answer booklet provided.

4. Formulae are provided in the appendix section.

Please answer ALL questions and show the necessary working. Total mark is equal to 100.

Question 1

a) Find the general solution of the differential equation
$4y''+24y'+37y=0 \quad , \quad y(\pi)=1 \quad , y'(\pi)=0$. (11 marks)

b) Find the general solution of nonhomogeneous differential equation
$y''-4y'-12y=3e^{5x}$, $y(0)=\frac{18}{7}$, $y'(0)=-\frac{1}{7}$. (14 marks)

[25 marks]

Question 2

a) Find a Fourier series for $f(x)=x, 0<x<4, f(x+4)=f(x)$. (11 marks)

b) Determine the Fourier series for the function defined by:

$$f(x)=\begin{cases} -1, & -\pi<x<-\frac{\pi}{2} \\ 1, & -\frac{\pi}{2}<x<\frac{\pi}{2} \\ -1, & \frac{\pi}{2}<x<\pi \end{cases}$$

which is periodic outside of this range of period 2π. (14 marks)

[25 marks]

Question 3

a) Determine $\mathcal{L}\{e^{3t}+\cos(6t)-e^{3t}\cos(6t)\}$. (6 marks)

b) Find the inverse Laplace transform of the function $F(s)=\frac{8}{3s^2+12}+\frac{3}{s^2-49}$. (5 marks)

c) Use the Laplace transforms to solve $y''-10y'+9y=5t$, with initial conditions $y(0)=-1$ and $y'(0)=2$. (14 marks)

[25 marks]

Continued...

Question 4

a) In a research study shows that 70% of MMU's student come to MMU Melaka campus to attend classes by car. If the possibility that students will be late attend the class is 10%. Due to traffic jam issue, they will tend to be late to attend the class by 80% if using other transport.

i. Construct a tree diagram to illustrate this situation. (3 marks)

ii. Find the probability that a student will be late attend the class. (3 marks)

iii. Given that a student will not be late attending the class, find the probability that he/she comes to MMU Melaka campus by car. (3 marks)

b) Given that the mass of a packet of biscuits is normally distributed with mean mass of 250g and standard deviation of 9g. Calculate the probability of the packet of biscuits that chosen at random with mass between 244.5g and 254.5g. (6 marks)

c) In a research study, the performance of MMU students in Mathematics subject for the final examination is influence by the study hours before the examination date. This study has been conducted on 40 male and 40 female students. It has been claimed that the mean number of study hours for girls is always higher than the mean number of study hours for boys. The statistics are summarized below.

Gender	Female	Male
Mean	4.2	3.6
Standard deviation	1.2310	1.3359

At 5% significance level, can we conclude that the claim is true? (10 marks)

[25 marks]

End of Page.

APPENDICES

Quadratic formula $m = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Differential Equation

Roots	General Solution
$m_1 \neq m_2$	$y = A\,e^{m_1 x} + B\,e^{m_2 x}$
$m_1 = m_2$	$y = (A + Bx)e^{m x}$
$m = \alpha \pm \beta i$	$y = e^{\alpha x}(A\cos\beta x + B\sin\beta x)$

Constant Coefficient of Non-Homogeneous Equations

$y = y_c + y_p$ [y_c: complementary solution, y_p: particular solution]

Annihilator for special functions

Annihilator	
D^n	$1, x, x^2, x^3, x^4, \ldots\ldots, x^{n-1}$
$(D-a)^n$	$e^{ax}, xe^{ax}, x^2e^{ax}, x^3e^{ax}, x^4e^{ax}, \ldots\ldots, x^{n-1}e^{ax}$
$(D^2 - 2aD + (a^2+b^2))^n$	$e^{ax}\cos bx, xe^{ax}\cos bx, x^2e^{ax}\cos bx, x^3e^{ax}\cos bx, \ldots\ldots, x^{n-1}e^{ax}\cos bx$ and $e^{ax}\sin bx, xe^{ax}\sin bx, x^2e^{ax}\sin bx, x^3e^{ax}\sin bx, \ldots\ldots, x^{n-1}e^{ax}\sin bx$

Fourier Series

$$F(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty}\left(a_n \cos\frac{n\pi}{L}x + b_n \sin\frac{n\pi}{L}x\right)$$

$$a_0 = \frac{1}{L}\int_{-L}^{L} f(x)dx$$

$$a_n = \frac{1}{L}\int_{-L}^{L} f(x)\cos\frac{n\pi}{L}xdx$$

$$b_n = \frac{1}{L}\int_{-L}^{L} f(x)\sin\frac{n\pi}{L}xdx$$

Integration Formula

$$\int \sin axdx = -\frac{1}{a}\cos ax$$

$$\int \cos axdx = \frac{1}{a}\sin ax$$

$$\int x\sin axdx = \frac{1}{a^2}(\sin ax - ax\cos ax)$$

$$\int x\cos axdx = \frac{1}{a^2}(\cos ax + ax\sin ax)$$

$$\int x^2\sin axdx = \frac{1}{a^3}(2ax\sin ax + 2\cos ax - a^2x^2\cos ax)$$

$$\int x^2\cos axdx = \frac{1}{a^3}(2ax\cos ax - 2\sin ax + a^2x^2\sin ax)$$

Transformation of some functions

$f(t)$	$L\{f(t)\}$
1	$\frac{1}{s}$, s>0
t	$\frac{1}{s^2}$
t^n	$\frac{n!}{s^{n+1}}$ $n = 1,2,3,\ldots$
e^{at}	$\frac{1}{s-a}$, s>a
$t\,e^{at}$	$\frac{1}{(s-a)^2}$
y'	$sY(s)-y(0)$
y''	$s^2Y(s)-sy(0)-y'(0)$

$f(t)$	$L\{f(t)\}$
$\sin \omega t$	$\frac{\omega}{s^2+\omega^2}$
$\cos \omega t$	$\frac{s}{s^2+\omega^2}$
$\sinh \omega t$	$\frac{\omega}{s^2-\omega^2}$
$\cosh \omega t$	$\frac{s}{s^2-\omega^2}$
$(1)u(t-a)$	$\frac{e^{-sa}}{s}$
$(t-a)u(t-a)$	$\frac{e^{-sa}}{s^2}$

Second Shift Theorem

$$L\{f(t-a)u(t-a)\} = e^{-as}L\{f(t)\}$$
$$L\{f(t)u(t-a)\} = e^{-as}L\{f(t+a)\}$$

Binomial Probabilities $\binom{n}{x}p^x q^{n-x}$

Key formula for Poisson Probability Distribution :

- If $\mu = \lambda$
  - i. $P(X=r) = Poi(r) - Poi(r-1)$
  - ii. $P(X \geq r) = 1 - Poi(r-1)$
  - iii. $P(X \leq r) = Poi(r)$
  - iv. $P(X > r) = 1 - Poi(r)$
  - v. $P(X < r) = Poi(r-1)$
  - vi. $P(a \leq X \leq b) = Poi(b) - Poi(a-1)$

Binomial Formulae when using Cambridge Statistical Table

Key formulae for Binomial Probability Distribution:

- If $p \leq 0.5$
  - i. $P(X=r) = B(r) - B(r-1)$
  - ii. $P(X \geq r) = 1 - B(r-1)$
  - iii. $P(X \leq r) = B(r)$
  - iv. $P(X > r) = 1 - B(r)$

v. $P(X < r) = B(r-1)$
vi. $P(a \leq X \leq b) = B(b) - B(a-1)$

- If $p > 0.5$
  i. $P(X = r) = B(n-r) - B(n-r-1)$
  ii. $P(X \geq r) = B(n-r)$
  iii. $P(X \leq r) = 1 - B(n-r-1)$
  iv. $P(a \leq X \leq b) = B(n-a) - B(n-b-1)$

Normal Distribution $Z = \dfrac{X-\mu}{\sigma}$

Hypothesis Testing

	Mean	**Proportion**
One Population	$z = \dfrac{\bar{x} - \mu_0}{\sigma/\sqrt{n}}$	$Z = \dfrac{p - p_0}{\sqrt{p_0(1-p_0)/n}}$
Two Population	$z = \dfrac{(\overline{x_1} - \overline{x_2}) - (\mu_1 - \mu_2)}{\sqrt{\dfrac{\sigma_1^{\,2}}{n_1} + \dfrac{\sigma_2^{\,2}}{n_2}}}$	$z = \dfrac{(p_1 - p_2)}{\sqrt{p_p(1-p_p)}\sqrt{\dfrac{1}{n_1} + \dfrac{1}{n_2}}}$ where $p_p = \dfrac{x_1 + x_2}{n_1 + n_2}$